Brief Summary of Work Completed or in Progress Regarding Pharmaceuticals and Personal Care Products (PPCPs) and Their Removal by Septic Systems

Work described herein is conducted with support from the Massachusetts Department of Environmental Protection under the United States Environmental Protection Agency - Section 319 competitive grant program. The grants were provided to the Barnstable County Department of Health and Environment (BCDHE) and most were linked to efforts of the Massachusetts Alternative Septic System Test Center (MASSTC). The primary contact is George Heufelder, Director 508-375-6616.

Initial Investigations – Removal of Selected Contaminants of Emerging Concern by Septic Systems

Initial work on the removal of 24 PPCPs in septic systems was conducted on alternative septic systems in 2006 (~$10,000 in a joint project with USGS in 2006). The data suggested that there was very little removal in the proprietary treatment units tested. The generic types of treatment units tested included trickling filters, packed bed filters, aerobic treatment unit, a sulfur upflow unit following pretreatment, recirculating sand filter and conventional soil system (tested percolate beneath system following 2 ft. of "Title 5" of sand). The results of this study were part of a report by the USGS and presented by Mac Zimmerman (USGS) and George Heufelder (BCDHE) at various local and regional venues.

The report, which is a summary of all presentations made, is available online at http://www.masstc.org/projects/initial-investigations-removal-of-selected-contaminants-of-emerging-concern-by-septic-systems.

Results from this study suggested that the soil based system, even though the soil used was predominantly sand, provided better removal than manufactured units.

LIMITED FOLLOW UP

Follow up work with only a few samples compared a drip dispersal system (following aerobic treatment) and a system that used ultraviolet light and peroxide. No official report was issued on these limited results.

These few samples suggested that the drip system (a shallow soils-based treatment component) might show promise to remove high percentages of PPCPs.

WHITE PAPER

White Paper -Contaminants of Emerging Concern from Onsite Septic Systems- Published April 2012 – The literature to that date was reviewed with particular emphasis on determining relevant issues to Barnstable County and the prevalence of septic systems in close proximity to groundwater used for drinking water and surface water resources. The White Paper is available at MASSTC.org.

This review identified endocrine disrupting compounds as the most significant potential impact in the area due to the sensitivity of the human and wildlife receptors. Secondly the potential for toxic effects (in particular cancer therapy drugs) was considered the second most important concern. Despite the importance of proliferating microbial resistance to antibiotics when wastewater is discharged to the surface, the report concluded that this issue is tertiary to the other two health/environmental impacts of PPCPs in septic system disposal and may be minimal in Barnstable County's geologic setting.

The report is available at http://www.masstc.org/library/2013/08/TheFinalWhitePaper1.pdf

FIELD PROJECT – Investigation of the Treatment of Drip Dispersal Onsite Septic Systems for the Removal of Selected Micro-Constituents and Contaminants of Emerging Concern

(http://www.masstc.org/projects/pharmaceuticals-endorcrine-disruptors-and-personal-care-product-attenuation-in-onsite-septic-system-drip-dispersal-systems)

The use of drip dispersal, a shallow soils-based treatment for onsite wastewater systems, was investigated and three rounds of PPCP samples over three years of data were collected. Although the project also attempted to determine the effects of air enhancement of the soil profile, technical aspects of the air delivery precluded that analysis. The results of six replicates were presented.

The final report will soon be available at
http://www.masstc.org/library/2013/08/AttempttoIndex1.pdf

The report compares the drip dispersal method of treatment with 15 inches of sand and grass turf above the dispersal with selected conventional treatment measures. The removal efficiencies of the selected compounds using drip dispersal reported approach 100%. The data suggest that septic systems employing shallow soils-based means for ultimate disposal may offer comparable to better treatment for certain micro-constituents of wastewater compared to some municipal wastewater treatment facilities. The fire retardant TCEP (Tris (2-chloroethyl) phosphate) was not attenuated during treatment and, similar to the conclusion reached in other studies, may prove to be a particular challenge for wastewater treatment removal strategies.
http://www.masstc.org/library/2013/08/AttempttoIndex1.pdf

Field Projects in Progress

FIELD PROJECT – The removal of selected pharmaceuticals and personal care products (PPCP) using shallow low-pressure distribution systems.

Investigation of shallow drainfields for the removal of PPCPs began with one year of concurrently sampling the drip dispersal project. One round of samples has been analyzed. Two rounds of samples are presently awaiting final analysis at University of Massachusetts Amherst, Special Environmental Analysis Program; a joint effort between the Environmental Analysis Laboratory and the University of Massachusetts Amherst Environmental & Water Resources Engineering Program. The project endeavors to determine whether shallow drainfield are as effective at removing PPCPs as drip dispersal. Shallow drainfield are essentially low-pressure distribution systems that discharge to shallow soil horizons. They discharge septic tank effluent (that is there is no pre-treatment) through a low pressure network of discharge pipes. The use systems are not presently approved in Massachusetts (although the discharge of untreated septic tank effluent thought one drip-dispersal manufacturer is allowed).

This study will allow the investigation of air-introduction as a variable and details are available at http://www.masstc.org/projects/the-removal-of-selected-pharmaceuticals-and-personal-care-products-ppcp-using-shallow-low-pressure-distribution-systems.

FIELD PROJECT - Investigation of soil types and the removal of PPCPs from septic tank effluent.

Investigations to this point suggest that residence time in the treatment process may affect the extent of PPCP removal. Finer textured soils in septic systems are loaded at lower hydraulic loading rates and intuitively provide more surface area for treatment and longer residence times in the treatment process. This new project endeavors to compare three soil types commonly found and approved for use (sand, loamy sand, and sandy loam) and determine whether there are differences in the ability to treat for PPCP at the prescribed (Title 5 – 310 CMR 15.00) hydraulic loading rates. The project is partially constructed and testing will commence in October of this year.

Details are available at http://www.masstc.org/projects/2-investigation-of-soil-types-and-the-removal-of-ppcps-from-septic-tank-effluent

Investigation of the feasibility of using Yeast Estrogen Screen (YES) for the rapid determination of endocrine disruption potential.

One of the chief impediments of conducting research on PPCP and septic systems is the costs of analyses. Previous work points to endocrine disruption as the most insidious and far reaching effects of wastewater discharge in our unique (Barnstable County) geological setting. This project endeavors to investigate the feasibility of using a Yeast Estrogen Screen (YES) as a surrogate measure of endocrine disrupting potential. YES is a methodology that has undergone a number of modifications since its inception in 1996. Basically, certain yeast have been genetically modified to show measurable effects when exposed to estrogenic compounds at very low levels. If successful, this rapid screening tool will be developed within the limits of the budgetary constraints and applied to a number of treatment systems presently being tested at MASSTC, and some environmental setting that are the subject of surface and drinking water studies. Details are available at http://www.masstc.org/projects/investigation-of-the-feasibility-of-using-yeast-estrogen-screen-yes-for-the-rapid-determination-of-endocrine-disruption-potential